Report for 2005MT60B: STUDENT FELLOWSHIP: The relationships between flood frequency, microhabitat variability, and riparian vegetation spacial pattern in montaine steams of western Montana

Publications

- There are no reported publications resulting from this project.

Report Follows

The relationships between flood frequency, microhabitat variability, and riparian vegetation spatial pattern in montane streams of Western Montana

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Abstract

Flooding plays an important role for spatial pattern of vegetation species in the riparian zone. However, its effects may not be clear due to presence of intermediate processes and spatial autocorrelations. I investigated relationships between environmental variables (flood frequency, soil, and light), spatial pattern of different vegetation measures (herb cover, shrub cover, tree density, and tree basal area) in three riparian zones of mountain streams from Western Montana. I used two methods, the boundary analysis and partial Mantel test, to quantify spatial relationships between environmental factors (flood frequency, soil, and light) and vegetation. The partial Mantel test can remove influence of a third variable, which may have confounding effect on the relationship of interest, and influence of spatial autocorrelation of vegetation. The boundary analysis computes the degree of spatial co-occurrence between two boundaries, defined as locations of high turnovers (species or variables).

The preliminary results (using standardized elevation instead of flood frequency) of partial Mantel tests from Mission Creek show minimum influence of spatial autocorrelation on all vegetation measures in spite of significant Moran's I values (a measure of spatial autocorrelation) in some vegetation measures. In the study area located at the north side of the creek, Mantel statistics between herb cover and light is considered as both statistically and ecologically significant while in the south side almost all the relationships between vegetation and variables are statistically and ecologically significant. The results based on the boundary analysis show higher co-occurrences of boundaries between vegetation and variables, and also among variables in the south side. These results suggest existence of a strong underlying driver affecting environmental variables in the south side. However, the major driving factor affecting herb species in Mission Creek site appears to be light because significantly strong relationships between herb and light remain even after removing space, elevation, and soil factors whereas the relationships become ecologically insignificant for elevation and soil after removing light. In Mission Creek, physical factors drive spatial pattern of vegetation species, but a major driver differs for different vegetation measures and different study areas.

Research Accomplishment

Vegetation, hydrological, and environmental data were gathered from three riparian zones along Kootenai and Bear Creeks from the Bitterroot Range and Mission Creek from the Flathead Indian Reservation in Western Montana during the 2005 field season. Each study site consisted of two to three study areas located on both sides of the stream. A size of each area ranged from 24 to 32m (along the stream) by 40 to 100m (across the valley). In 100 to 166 quadrats (plots) of 4 by 4 m, the basal area of all tree and shrub species more than 3.5cm in circumference at the breast height were measured, and their presence-absence were recorded. Each 4 by 4m plot was stratified into two 2 by 2m plots, and 2 by 2m plot was stratified into for 0.5 by 0.5m plots. The cover of shrub species (>30cm in height, <3.5cm in circumference) was estimated, and the presence-absence were recorded in all 2 by 2m plots. The cover of herbaceous species (<30cm) was estimated, and the presence-absence were recorded in one or two 0.5 by 0.5m plots randomly selected from each 2 by 2m plot. Understory plots (shrub and herb) within each 4 by 4m plot were combined to obtain average cover scores in order to compare different vegetation types and environmental variables at the same scale (4 by 4m). Ten to fifteen 2.54 by 10.16cm soil subsamples were taken from each 4 by 4m plot to form one representative sample of the plot. At each subsampled location, the depth of the organic horizon (O horizon) was measured. The soil samples have been analyzed for soil texture and pH. Hemispherical photos were taken at the center of the 4 by 4m plots to calculate the canopy openness by Gap Light Analyzer. A series of flow measurements were made in Kootenai Creek and Bear Creek while the flow data from the nearby USGS gauge were used for Mission Creek. The main and side channels were surveyed in the approximately 5m interval through the study areas. The study site topography was surveyed by a total station survey equipment. The boundary analysis and partial Mantel tests were performed on Mission Creek data using all vegetation types and all environmental data except flood frequency. Hydraulic modeling is underway using HEC-GeoRAS (combination of one dimensional flow model and TIN floodplain map) to estimate flood frequency for each plot. Instead, one elevation value for each 4 by 4m plot was assigned by averaging all the elevation points from the total station survey within the plot, and then the plot elevation value was standardized according to the valley slope for partial Mantel tests. Average elevation values were used for the boundary analysis.

Preliminary Conclusion

In Mission Creek, two study areas were placed in north and south side of the creek, and two areas show different floodplain topographies even though the dominant species remains western red cedar (*Thuja plicata*). In the south side, elevation increases monotonically from the channel where as the north side is dissected by side channels. Flooding is the ultimate driver of the system, but its influence varies temporally and spatially depending on vegetation types and topographic features. The preliminary results from Mission Creek show higher Mantel statistics and spatial boundary co-occurrences between vegetation and variables and among variables in monotonically changing topography. A major driver appears to be light for herb species in both study sites, and this may be attributable to conifer dominance of the study areas. Insignificant Mantel statistics in the north side and negative spatial co-occurrences of boundaries between tree basal areas and variables in both north and south sides suggest temporal variability of environmental factors and that the spatial patterns of tree basal area are not readily explicable by the current environmental conditions.

Spatial autocorrelation is often present in vegetation data as plots located closer in geological locations share similar vegetation composition and abundance (positive autocorrelation) than they are further apart. In spite of the fact that there are positive autocorrelation at short scale for most of the vegetation measures, the results from partial Mantel tests suggest spatial autocorrelation plays a minor role in vegetation spatial patterns in Mission Creek study areas. Spatial autocorrelation may become an important factor if a grain size (plot size) and extension of study site are changed.